Experimental Investigation of Thermophysical Properties for Hafnium Carbide (up to 5000 K)

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The aim of this work is to study the thermophysical properties of hafnium carbide in the solid and in the liquid state. The most refractory substance, as shown by published studies (for example, [1]), is graphite (4800-4900 K). The properties of the most refractory carbides and nitrides have been investigated during many years, but we don’t know their melting temperatures well up to this date. The value of the measured melting temperature depends on the choice of normal spectral emissivity in the literature. Moreover, it was stated in [2] that the most refractory carbide is HfC hafnium carbide. In this connection, a search is being made for more refractory substances based on mixtures of carbides and nitrides. The only method for obtaining data on materials at temperatures over 2000 K is the pulsed heating by an electric current or a laser pulse. In this paper, an electrical pulse was used, since this allows one to obtain bulk characteristics of a substance, in particular heat capacity and electrical resistivity. Since most refractory materials are studied for the first time in the temperature range from 3500-4000 K and above, the values of their emissivity $\varepsilon$ (necessary for obtaining the temperature) are unknown. In this connection, the required quantity $\varepsilon$ is extrapolated from the region of lower temperatures, or the literature data of the old years are taken, as in [2], the reliability of which is doubtful, which introduces a significant error in the temperature measurements [3]. The application of the specimen in the form of a blackbody model allows solving this problem. In particular, in [4] a wedge-shaped black body model was used, for which the value of the effective emissivity was 0.95. The wedge-shaped model of a black body for hafnium carbide consists of the two thin plates. Actually, it is a thin film (thickness about 1 µm), obtained by magnetron sputtering in a vacuum, as in [5]. The report will be presented: the melting point of hafnium carbide; input energy; specific heat; electrical resistivity (referred to initial dimensions) in the temperature range of 2500 – 5000 K, that is, upon melting and in the liquid state.

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References: